ORIGINAL ARTICLE

Delays in Starting Morning Operating Lists

An Analysis of More Than 20 000 Cases in 22 German Hospitals

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SUMMARY

Introduction: Delays in the start of the first operation of the day often lead to conflicts among the involved physicians and nurses. Data on such delays have already been published for individual hospitals, but robust comparative data from a large number of institutions have not been available till now.

Methods: The study is based on the operating room (OR) documentation of four surgical services (general surgery, trauma/orthopedic surgery, gynecology, and ear nose throat [ENT] surgery) in 22 German hospitals over a nine-month period. Three process points ("patient arrival in OR suite," "anesthesia ready," and "incision") were analyzed for the first operation of the day in each OR.

Results: 21 357 operations in the first position were analyzed. The percentage of delays differed markedly for the three process points. The incision was delayed in more than 70% of the general surgical and trauma/orthopedic cases, but less often in gynecological ($61 \pm 24\%$) and ENT cases ($42 \pm 29\%$). The frequency of delays longer than 10 minutes was between 20% and 40%. The mean delay in delayed cases ranged from 14.1 ± 5.4 to 21.6 ± 8.2 minutes depending on the type of service and process point.

Conclusion: The processes for the first operation of the day are not optimally structured in the hospitals whose cases were analyzed in this study. Delayed starts were common.

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The particular complexity in the organization of operating rooms (ORs) stems from the multiplicity of disciplines involved, from the coordination of different professional groups' work, and from the many interfaces inherent in OR and patient preparation. Furthermore, everything needs to be finished "just in time."

The morning OR start has been a focus of conflict in operating room management over many years (1–5). Delay entails the loss not only of (extremely) expensive production capacity, but also, significant conflict between the professional groups involved (2, 5).

The beginning of the morning list depends largely on three time factors:

- Transfer of the patient from the ward or the waiting room to the OR
- Preparation and induction of anesthesia
- Positioning of the patient and surgical preparation (Figure 1).

Only at this point is preparation completed, and delays can occur at any and every stage (6).

To improve the situation, many hospitals have over the last 10 years established a formal operating room management structure to coordinate the functions of the different professional groups involved, with the primary intent of improving standards generally to the benefit of the entire hospital. To aid operating room management, objective comparative data, so called benchmarking, needs to be available (7–9). Only via benchmarking can the individual institution evaluate its own performance. Until now, only isolated reports on morning operating room start from single centers are available, and data from these does not allow structuring of realistic benchmarks.

The aim of this study was to generate objective and differentiated benchmarks regarding the delay of OR morning start. The underlying question was how good the OR teams were, despite the large number of people involved, in meeting their own goals in process performance.

Methods

In 2010 the German Association of Operating Room Management (*Verband für OP-Management*, VOPM); the German Society of Anesthesia and Intensive Care Medicine (*Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin*, DGAI); the Association of

Working Group on Process and Cost Management, Forum of Quality Management and Economics of the German Society of Anaesthesiology and Intensive Care Medicine and the Association of German Anaesthesiologists: PD Dr. med. Schuster, Prof. Dr. med. Bauer

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Outline of perioperative process up to time of incision

German Anaesthesiologists (*Berufsverband Deutscher Anästhesisten*, BDA), and the Association of German Surgeons (*Berufsverband der Deutschen Chirurgen*, BDC), established a benchmark program for operating room processes. This benchmark program is, in principle, open to all German hospitals, and allows the participating individual institution to compare its processes and results with all other participants. The participating hospitals send monthly reports of the standardized process data to the independent IT Service Co. Digimed. Digimed developed the benchmark database and handles the data for the operating room reporting and benchmarking of the hospitals. In principle, hospital participation is voluntary. At the time of this study 58 hospitals submitted data for the benchmark program. For our study, data from 22 hospitals was chosen for analysis because, within the duration of the study, their submissions included all three process time parameters in their routine documentation.

Data from January to December 2011 was used. All managers from participating hospitals confirmed that prompt OR start in the morning was of great or supreme importance for hospital management. Four surgical disciplines, common to many hospitals despite differences in capacity, were chosen for analysis:

- General surgery (GS)
- Trauma/orthopedic surgery (TS)
- Gynecology (GYN)
- Ear nose throat surgery (ENT).

The three process time parameters recommended by the above-mentioned associations as being of high or highest priority were:

- Patient arrival in OR suite
- Anesthesia ready
- Incision.

TABLE 1

The studied surgical disciplines, and the number of included first cases

	Number of OR suites	Number of first cases
General surgery	17	6213
Trauma/orthopedic surgery	18	8243
Gynecology	14	3603
Ear nose throat surgery	15	3298

OR, operating room

The definition of the process time parameters reflects the time points P3, A7, and O8 in the recommendations of the associations (10). Point P3 concerns delays in process prior to operating room (OR) arrival (in particular patient transport to the OR). A7 concerns, primarily, delays during administration of anesthesia, while O8 concerns delays associated with surgical preparation.

The three time parameters were defined by OR management dependent on surgical discipline, and individual hospital-specific ambition before participation in the benchmarking project. This entailed different time targets on different days (e.g. in the event of continuing education sessions on a particular day). The total delay in minutes is measured from the predetermined time of the first target. This means that if arrival in the OR suite is delayed, it is likely that the second target, “anesthesia ready,” will not be attained. This reflects the actual situation in the OR organization that delay in any preceding target time will affect subsequent target times which cannot be changed, since it is technically hardly possible, and not practical, to inform all concerned in good time.

A prerequisite of inclusion of any operative discipline in the analysis was that the submitting hospital must have established target times for each of the three process time parameters, and that all three times must be documented in at least 90% of cases. As in comparable retrospective data analyses of OR processes, if the target time was exceeded by more than 90 minutes, the case was excluded. In general, such delays reflect process change (e.g. delayed commencement of organ transplantation because of delay in organ delivery; OR closure because of technical defect) (11). Cases were only included when planned time of arrival to the OR suite was before 9 a.m.

Microsoft Excel was used for data analysis giving mean values and standard deviation, when not otherwise noted. The data concerned time and numbers alone, not at all patient identification. In consequence, ethics committee approval was thought not to be necessary, and not sought.

Findings

A total of 21 357 operations in first position were analyzed. For each surgical specialty considered in our study, the number of operating room suites and of patients involved, are shown in *Table 1*. The lowest number of patients was 3298 in the ENT group, and the highest, 8243 in the trauma and orthopedics group.

Delays in meeting time targets are shown in *Figure 2*. Delay in incision time was registered in more than 70% of cases in general and trauma/orthopedic surgery, somewhat less in gynecology and ENT. In the general and trauma/orthopedic surgery groups delays increased at each process step, but not in the ENT group. *Table 2* shows average delays in each target time related to the four surgical disciplines varying between 14.1 ± 5.4 , and 21.6 ± 8.2 minutes.

To eliminate the effect of minimal delays on overall frequency of delays, a second analysis was carried out,

FIGURE 2

Total number of delayed first cases. Proportion of delayed cases in all first cases on the list, in the four surgical specialties studied and for three time targets: “time of arrival in the operating room,” “anesthesia ready,” and “incision time”

TABLE 2

Delays in each surgical specialty*

	Patient arrival in operating room suite	Anesthesia ready	Incision
General surgery	19.7 ± 10.5	17.7 ± 5.5	21.4 ± 5.2
Trauma/orthopedic surgery	17.5 ± 7.6	18.3 ± 2.6	18.9 ± 4.2
Gynaecology	21.6 ± 8.2	16.1 ± 5.3	18.6 ± 3.5
Ear nose throat surgery	16.9 ± 10.5	16.0 ± 4.4	14.1 ± 5.4

* shown is the mean delay in minutes (±standard deviation) for each specialty

FIGURE 3

Delays to the first case of >10 minutes. Proportion of first cases delayed by more than 10 minutes in each of the four surgical specialties studied, for three time targets: “time of arrival in the operating room,” “anesthesia ready,” and “incision time”

FIGURE 4

Delays in “anesthesia ready” and incision despite timely arrival in the operating room: proportion of delayed cases in all first cases on the list, in the four surgical specialties studied and for the time targets: “time of arrival in the operating room,” “anesthesia ready,” and “incision time”

this time including only delays of more than 10 minutes. Delay times fell markedly, but still lay between 20% and 40% (related to incision time) (Figure 3). Increasing delays over the consecutive process steps are most prominently seen in trauma surgery.

Because delay in arrival to the OR suite was very frequent and affected subsequent target times, in a further analysis only cases where there was no delay in arrival to OR suite were considered (Figure 4). There were 12 249 such cases. Very marked delays remained evident at both target times of “anesthesia ready,” and “incision.”

Attainment of target times depends on the predetermined time allotted to each process (induction of anesthesia, positioning of the patient and surgical preparation) (Table 3). Target times determined by the individual hospitals for induction of anesthesia lay between 24.0 ± 5.2 minutes (ENT), and 26.7 ± 6.2 minutes (TS), a slight difference. There was a more marked difference in the allotted times for surgical preparation which varied from 13 ± 4.7 minutes (ENT), to 19.7 ± 6.2 (TS).

Discussion

Delay associated with the OR start in the morning are among the most frequent causes of conflict in operating department management. Under certain circumstances such as overutilization of the OR and resulting overtime payments, delayed OR start in the morning results in a direct increase in costs. Even more costly, in in-

direct ways, in the opinion of many managers, is the frustration and conflict between colleagues, and the counterproductive climate engendered by a day which begins with delay and affects the morale of all involved.

For this study, for the first time extensive comparative data on morning operating room processes in different surgical disciplines was collected from hospitals of varying size. By comparison with previously published studies from individual hospitals, the scope of the data, and the number of hospitals and surgical disciplines concerned, give this study particular weight.

The frequency of delay found was very high, affecting 40–70% of cases. Even when delays only of more than 10 minutes were considered, there was still a delay of 20–40% at time of incision.

It is important to note that it was not an aim of this study directly to compare hospital, and operative discipline efficiency. Before any conclusions of this nature could be drawn, extensive further information would be necessary, e.g. on the availability of transport personnel, the manning of OR personnel, and the complexity of patient positioning. The overriding aim was to find out if the target times matched the actual times, and this was evidently not so.

The very high frequency of delay may be surprising at first sight, but is in fact similar to that in previously published studies (2–4, 6), where delays in OR morning starts were observed in 28%, 66%, and 78.7% of cases. The causes of delay are many. In earlier, mostly

American publications, late arrival of surgeons, and delay in patient transport (2–4), were most cited. The authors therefore focused primarily on educative measures to reduce the delays.

In one study from a university hospital published in 2009 by Unger et al. (6), the frequency and reasons for not attaining target time set by OR management for “anesthesia ready” were studied. After grouping similar reasons, the main reasons were:

- Organizational causes:
 - Problems with patient transport to the OR
 - Change in OR lists
 - Incomplete patient evaluation and documentation
 - Lack of anesthesia personnel
- Delay in “anesthesia ready.”

Overall, delays in establishment of anesthesia were found in 27.5%, with an average delay of 19.3 minutes. Subsequently, the study group modified patient transport procedures, arranged an earlier engagement of the anesthetist in complex inductions, and ensured more focus on organization and observance of target times by the institution of daily reports. Two years later, the rate of delay was reduced to 13.4% (unpublished data).

Time taken for induction of anesthesia varies markedly, and, apart from technique, the continuing education of the anesthetist is also a significant factor (12, 13). Prediction of time necessary for induction is difficult, even for experienced anesthetists (14). Supervision of trainees is also a cause of delay (15).

High achievement rates in realizing target times for induction of anesthesia entail the risk of anesthetists beginning too early in order to ensure induction is finished within target time. It is then very likely that he or she must wait for the surgeon (16). From the other point of view, a surgeon arriving early must more often wait than a latecomer, but is, therefore, less often the cause of further delay. The psychology factor, the avoidance of waiting oneself at all costs may entail that others must wait. This might be one important reason for delay in OR start in the morning.

In any communication concerning target times, it is essential to emphasise the interdependence of all concerned. As shown in Figure 5, time of “anesthesia ready” approximates to a Gaussian Curve. When all concerned, on average, meet their target time, it is mathematically obvious that they will be late half of the time, and early the other half of the time.

If the whole process really runs virtually without delay, the previous process would have to be completed with a probability of e.g. 90% before the next begins. It is then unavoidable that one of the process participants waits for another, which means that the waiting time depends only on the mean and standard deviation of the process time (16).

Methodological limitations

Any study of operating room processes, including this one, is subject to inherent methodological limitations. Of particular significance is distortion caused by the

TABLE 3

Planned duration of process in minutes*

	Induction of anesthesia (min)	Surgical preparation (min)
General surgery	25.8 ± 5.7	14.8 ± 5.4
Trauma/orthopedic surgery	26.7 ± 6.2	19.7 ± 6.2
Gynecology	24.3 ± 5.8	13.9 ± 6.0
Ear nose throat surgery	24.0 ± 5.2	13.0 ± 4.7

* The median ± standard deviation are presented for each specialty

FIGURE 5

Time distribution before “anesthesia ready” and before incision time in trauma cases, relative to intended time.

Anesthesia ready is represented in olive green, incision in blue. Frequency distribution of deviation from target time, clustered in 5 minute intervals. Negative values imply achievement of target before the target time, positive values after target time

observer effect (the so-called Hawthorne effect). The fact that any process is observed and documented can entail marked differences in performance. In this study, we used retrospective routine data for investigation which avoids the observer effect. The disadvantage in such a retrospective analysis of routine data is the danger of the data not being representative, and of poor data quality.

Of critical note, the data contained no adjustment for the degree of difficulty of surgical procedures. It must be assumed that more complex surgery was undertaken in the larger hospitals, but the relevant data for the procedures studied here was not available.

With regard to anesthesia, it is known that the complexity of invasive procedures determines the time taken (12). If, and to what extent, surgical case complexity (e.g. as considered in the Case Mix Index [CMI]) determines surgical preparation time up to incision, has not been studied. Many factors not involved in surgical preparation are included in the CMI (e.g. cost of intensive care, implant cost, and time of hospital stay). Particularly in trauma surgery, many cases with low CMI require very long surgical preparation times. Also, the positioning and surgical preparation probably takes no longer for an extensive, complex laparotomy, than for a laparoscopic appendectomy.

Summary

Despite excellent planning and very good processes, avoidance of delay in the beginning of morning operating lists is not always achieved. Nevertheless, analysis of the data in this study suggests that there is a marked potential for improvement in process management in German hospitals. No conclusions could be drawn about causes for delay, nor can concrete suggestions for improvement be made. But it would appear from the literature that a reduction in delays is attainable.

Apart from clear definition of targets for each of the operative disciplines concerned, an essential prerequisite is the motivation of all participants. Recording of the morning target times, and of the achievement, or failure to achieve these times, is essential if the vicious circle of delay and of delay resulting from expected delay is to be broken.

Conflict of interest statement

PD Dr. Schuster and Prof. Bauer represent the Association of German Anaesthesiologists, Dr. Taube and Mr. Diemer represent the German Association for Operating Room Management. They are members of the scientific advisory board of the Benchmarking Program.

Mr. Pezzella BA and Dr. Bialas are employees of digmed GmbH.

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KEY MESSAGES

- Delays in operating room (OR) start in the morning are a frequent cause of conflict in German hospitals.
- The three most important target times for analyzing delays are: patient arrival in OR suite, anesthesia ready, and time of incision. Correspondingly, the important causes of delay relate to patient logistics, anesthesia and surgical processes.
- In more than 21 000 cases studied from 22 hospitals, delays in OR morning starts were registered in way over half of all cases, and occurred at each of the three target time points.
- Rigid data-controlled planning of OR processes is a prerequisite for smooth operating room performance.
- Precise realization of the planned process chain and a very good compliance of the personnel involved is essential to keep delays within an acceptable range.

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